

DESCRIPTIONS OF THE NYMPHAL INSTARS OF
OECLEUS BOREALIS (HOMOPTERA: FULGOROIDEA: CIXIIDAE)¹

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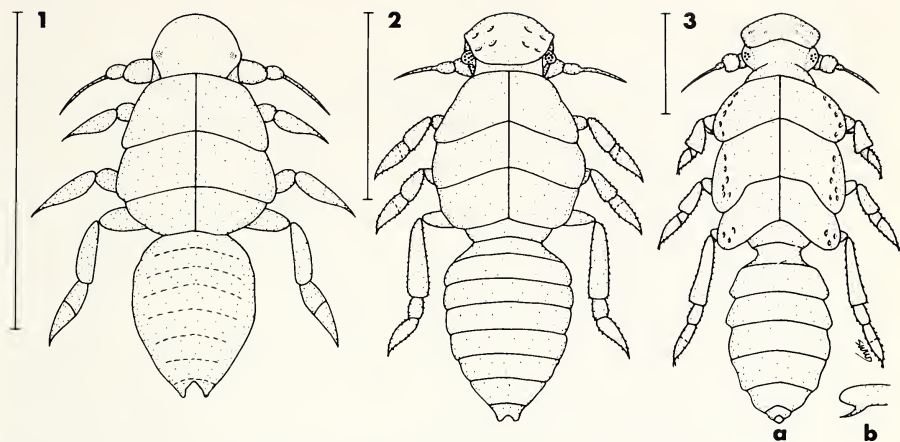
Abstract.—The 5 nymphal instars of *Oecleus borealis* Van Duzee are described and illustrated. Features useful in separating nymphal instars include the size, and form of teeth and spines on the profemora and tibiae, size of body and wingpads, and the numbers of pits, and metatarsomeres.

Oecleus borealis Van Duzee has been recorded from New York south to Florida and west to Michigan, Kansas, and Texas (Kramer, 1977). Adults have been collected on apple (*Malus* sp.), hickory (*Carya* sp.), New Jersey tea (*Ceanothus americanus* L.) and desert willow (*Chilopsis linearis* DC.) (Kramer, 1977). Information on the immatures of any cixiid is very limited as they are subterranean: Cumber (1952) described the immatures of *Oliarus atkinsoni* Myers, Myers (1929) described some immature stages of *Mnemosyne cubana* Stål and *Bothriocera signoreti* Stål. Wilson and Tsai (1982) recently provided detailed descriptions of the immatures of *Myndus crudus* Van Duzee. We describe the five immature stages of *Oecleus borealis* Van Duzee in this paper.

MATERIALS AND METHODS

Specimens to be described were collected by Tsai and Thompson at two localities in peninsular Florida (collecting data given below) and preserved in 70% ethyl alcohol. The first instar is described in detail, but only major changes from previous instars are described for subsequent instars. Comparative statements refer to previous instars (e.g., more numerous). Measurements are given in mm as mean \pm SE. Length was measured from apex of vertex to apex of abdomen, width across the widest part of the thorax,

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Figs. 1–3. Nymphs of *O. borealis*. 1. First Instar. 2. Second Instar. 3. Third Instar, a. Nymph, b. Median aspect of apex of profemur. Vertical bars = 0.5 mm.

and thoracic length along the midline from the anterior margin of the pronotum to the posterior margin of the metanotum.

Nymphs of *O. borealis* were first discovered in January 1975 by the junior author (CRT) in sand pine woods [*Pinus clausa* (Chapman)], 27–32 km east of Silver Springs, Marion Co. Florida in Ocala National Forest. The subterranean nymphs were found 30–45 cm deep in white sand areas where vegetation consisted of saw-palmetto [*Serenoa repens* (Bartram)] and turkey oak (*Quercus laevis* Walter) as well as sand pine. Nymphs were subsequently found in similar habitats in Orange and Broward counties. An adult reared from a late instar nymph was identified as *O. borealis* by J. P. Kramer, USNM. The economic importance of this insect is unknown.

Collecting data for the specimens used in the descriptions are: FLORIDA: Broward Co.: Ft. Lauderdale, 28 May 1982 (2 first instars), 23 July 1982 (1 third instar); Orange Co.: Orlando, 18 November 1982 (5 fourth instars, 12 fifth instars); Marion Co.: Ocala National Forest, 15 September 1982 (1 fourth instar), 18 June 1979, (1 first instar, 7 second instars, 3 fourth instars, 3 fifth instars; same locality, no date—1 third instar, 3 fifth instars).

DESCRIPTIONS OF THE NYMPHAL INSTARS

First instar (Fig. 1). Mean length 0.69; thoracic length 0.27; width 0.26. Three specimens examined.

Form elongate, subcylindrical, slightly flattened dorsoventrally, widest across junction of meso- and metathoraxes. Vertex, frons, thoracic nota, and

abdominal tergites with a few (less than 10) shallow indistinct pits. Body white.

Vertex broadly rounded anteriorly, slightly narrowing posteriorly. Frons with lateral margins convex and forming shelf-like carinae beneath eyes. Clypeus narrowing distally. Beak apparently 3-segmented [based on comparison with later instars and first instars of other cixiids e.g., *Myndus*; see Wilson and Tsai (1982)]; extending just beyond metacoxae. Eyes reduced, barely visible in ventral view, reddish. Antennae 3-segmented; scape and pedicel subcylindrical and subequal; flagellum bulbous basally, filamentous distally, bulbous portion ca. $\frac{1}{2}$ length of pedicel.

Thoracic nota divided by a longitudinal mid-dorsal line into 3 pairs of plates. Pronotum longest laterally; each plate subquadrate, anterior margin almost straight, posterior margin slightly concave, lateral margin broadly curved. Mesonotum with median length subequal to that of pronotum; each plate subquadrate, posterior margin slightly concave, lateral margin slightly convex. Metanotum with median length ca. $\frac{2}{3}$ that of mesonotum; each plate subquadrate, lateral margin sharply angled posteromedially. Pro- and mesocoxae posteromedially directed; metacoxae smaller, obscured by trochanters. Profemora with a slightly swollen appearance. Pro- and mesotibiae very short, ca. $\frac{1}{2}$ length of tarsi; metatibiae elongated, slightly longer than metatarsi. Tarsi 2-segmented, divisions between tarsomeres obscure; with a pair of tiny apical claws.

Abdomen apparently 9-segmented (although specimens were cleared in 10% KOH, segments were very difficult to see; the supposed number of segments is based on comparison with later instars and first instars of other cixiids (e.g., *Myndus*; see Wilson and Tsai, 1982), subcylindrical, widest basally; posterior-most segment surrounding anus.

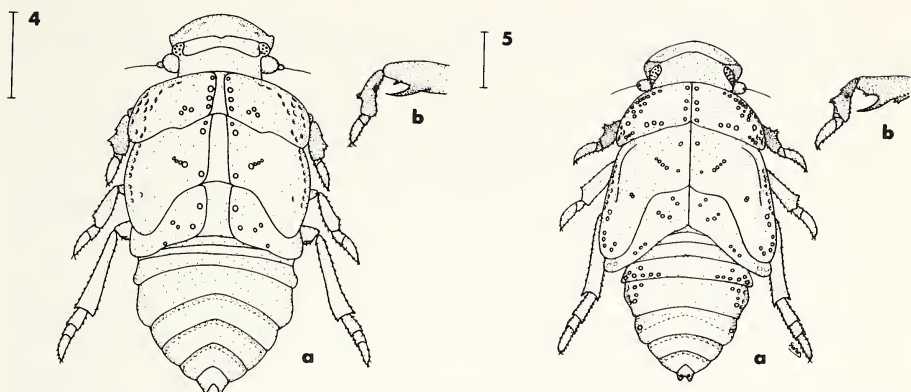
Second instar (Fig. 2). Length 1.05 ± 0.05 ; thoracic length 0.46 ± 0.03 ; width 0.46 ± 0.03 . Seven specimens examined.

Widest across mesothorax. Thoracic nota with pits generally more numerous. Pro- and mesotibiae with lengths subequal to those of tarsi. Otherwise, similar to first instar.

Third instar. (Fig. 3). Mean length 1.95; thoracic length 0.73; width 0.79. Two specimens examined.

Frons and clypeus with a continuous row of ca. 11 tiny black dotlike pits paralleling lateral margins. Beak with segment 2 ca. $2 \times$ length of segment 1; segment 3 subequal to 2. Antennae with bulbous portion of flagellum ca. $\frac{1}{4}$ length of pedicel.

Thoracic nota with pits generally more numerous. Pronotum with each plate bearing 4 pits paralleling median line and ca. 13–15 total pits on plate. Mesonotum with median length ca. $1\frac{1}{2} \times$ that of pronotum, distinctly lobate posterolaterally. Metanotum with median length ca. $\frac{2}{3}$ that of mesonotum; each plate with 1 pit in anteromedial corner, ca. 4 pits near middle and ca.



Figs. 4, 5. Nymphs of *O. borealis*. 4. Fourth instar. 5. Fifth instar, a. Nymph, b. Median aspect of apex of profemur, protibia, and protarsus. Vertical bars = 0.5 mm.

3 pits laterally. Profemora with ca. 0.05 mm curved spine in distal $\frac{1}{2}$. Pro- and mesotibiae subequal in length to tarsi; protibiae with small spine in distal $\frac{1}{2}$, metatibiae with a row of 5 very small spines apically.

Fourth instar (Fig. 4). Length 2.47 ± 0.19 ; thoracic length 0.98 ± 0.03 ; width 1.03 ± 0.05 . Nine specimens examined.

Frons and clypeus with a continuous row of ca. 20 tiny black dots paralleling lateral margins. Antennae with scape reduced and ring-like. Pronotum with each plate bearing 4 pits paralleling median line and ca. 20 pits on plate. Mesonotum with each plate bearing 1–2 pits near anteromedial corner, 1 pit near posteromedial corner, an oblique row of 4 pits near middle and an irregular row of very shallow pits (apparently absent in some specimens) paralleling lateral margin; wingpad lobate and covering ca. $\frac{2}{3}$ – $\frac{3}{4}$ of metanotal plate laterally. Metanotum with each plate bearing ca. 5 pits. Profemora with ca. 0.15 mm curved spine in distal $\frac{1}{2}$ and a very small tooth between spine and apex. Protibiae with a large bifid tooth in distal $\frac{1}{2}$, a small tooth proximal to it, and 1 large tooth on median aspect (Figs. 4A, B). Metatibiae with a row of 5 small black-tipped spines apically. Metatarsi 3-segmented; tarsomere 1 cylindrical with a row of 4 very tiny black-tipped spines apically; tarsomere 2 cylindrical with a small black-tipped spine on either side at apex; tarsomere 3 subconical, slightly curved and bearing a pair of slender apical claws.

Abdominal tergites 6–8 each with dorsoposteriorly oriented white waxpads in intermembranous areas posterior to tergal plates; waxpads probably paired and present but indistinct in earlier instars (see Wilson and Tsai, 1982).

Fifth instar (Fig. 5). Length 3.23 ± 0.11 ; thoracic length 1.34 ± 0.02 ; width 1.52 ± 0.04 . Eighteen specimens examined.

Frons and clypeus with a continuous row of ca. 16–25 tiny black dots paralleling lateral margins. Antennae with bulbous portion of flagellum ca. $\frac{1}{6}$ length of pedicel.

Pronotum with each plate bearing 4 pits paralleling median line and ca. 30 or more total pits on plate (many pits very shallow and obscure). Mesonotum with each plate bearing 1–2 pits near anteromedial corner, an oblique row of 5 pits near middle of plate and numerous shallow pits paralleling lateral margins; wingpad extending to or nearly to apex of metanotal wingpad. Metanotum with each plate bearing ca. 6–8 shallow, obscure pits. Profemora with ca. 0.2 mm curved spine in distal $\frac{1}{2}$ and a small unifid or bifid tooth distal to it on median aspect; on lateral aspect with 2 small teeth in basal $\frac{1}{2}$ and 1 small tooth in distal $\frac{1}{2}$. Protibiae with bifid tooth in basal $\frac{1}{2}$ in median aspect, bifid tooth near apex and 1 small tooth in basal $\frac{1}{2}$ of anterior aspect, and 1 tooth in basal $\frac{1}{2}$ of lateral aspect. Metatarsomere 1 with an apical row of 5 black-tipped teeth.

Abdomen with pits generally more numerous.

KEY TO THE NYMPHAL INSTARS

1. Metatarsi subdivided into 3 tarsomeres; profemur with small tooth distal to curved spine (Figs. 4, 5) 2
- Metatarsi subdivided into 2 tarsomeres; profemur without small tooth distal to curved spine or spine lacking (Figs. 1–3) 3
2. Mesothoracic wingpads extending to or nearly to apex of metathoracic wingpads (Fig. 5); metatarsomere 1 with an apical row of 5 spines Fifth Instar
- Mesothoracic wingpads extending at most $\frac{3}{4}$ length of metathoracic wingpads (Fig. 4); metatarsomere 1 with an apical row of 4 spines Fourth Instar
3. Profemur with curved spine in distal $\frac{1}{2}$ (Fig. 3b); thoracic length greater than 0.7 mm Third Instar
- Profemur without curved spine in distal $\frac{1}{2}$; thoracic length less than 0.6 mm 4
4. Protibia ca. $\frac{1}{2}$ length of protarsus; thoracic length less than 0.35 mm (Fig. 1) First Instar
- Protibia subequal in length to protarsus; thoracic length greater than 0.35 mm (Fig. 2) Second Instar

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